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FRANGIBLE PORT CLOSURE

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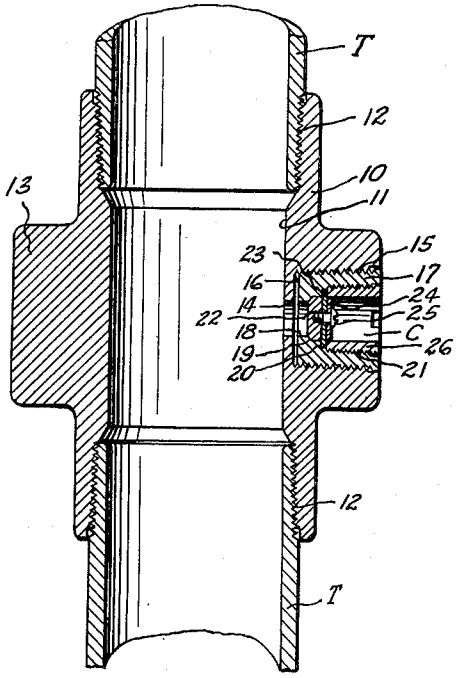


Fig. 1

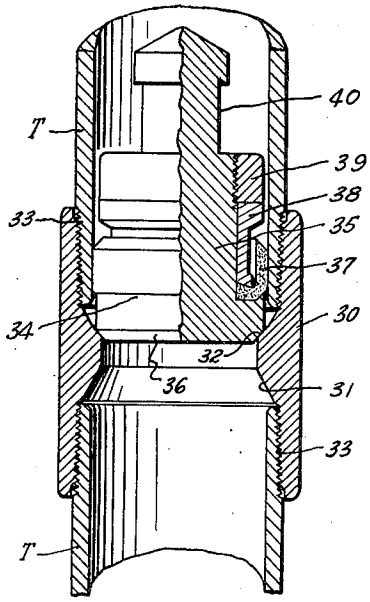


Fig. 2

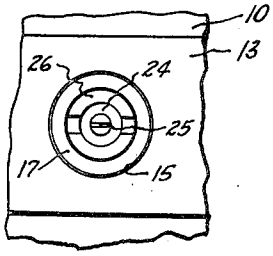


Fig. 3

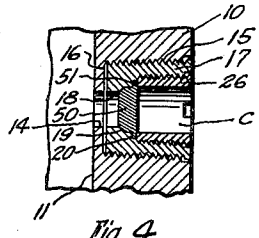


Fig. 4

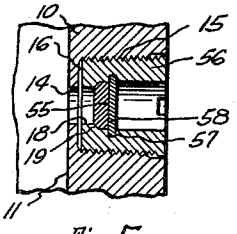


Fig. 5

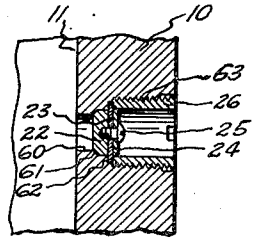


Fig. 6

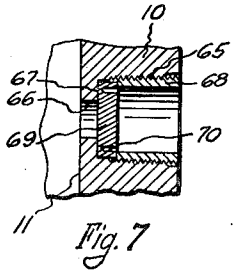


Fig. 7

Herbert C. Otis
Hubert C. Laird
INVENTORS

BY Christianson Ackley

ATTORNEY

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FRANGIBLE PORT CLOSURE

Herbert C. Otis and Hubert C. Laird, Dallas, Tex., assignors to Otis Engineering Corporation, Dallas, Tex., a corporation of Texas

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This invention relates to new and useful improvements in port closures.

It is one object of the invention to provide a closed port in a conductor or vessel, which port is adapted to be opened by means of fluid pressure from within the conductor or vessel.

An important object of the invention is to provide a port closure which is initially closed to prevent flow of fluids therethrough in either direction and wherein the means for closing the port will resist opening thereof until a predetermined fluid pressure differential is applied across the port to open it.

A further object of the invention is to provide a port closure, of the character described, wherein the closure means for the port is designed to withstand substantially as great a pressure from without the conductor as the conductor itself will withstand, whereby the normal use and functioning of the conductor is not affected or decreased by the provision of the port and closure device therein.

Still another object of the invention is to provide a fluid port having a plug secured therein to prevent flow through said port in either direction, said plug being displaceable completely from the port by application of a predetermined fluid pressure, and when displaced affording full unobstructed opening of the port.

A still further object of the invention is to provide a port closure of the character described which does not extend into the bore of the conductor in which it is mounted.

It is a particular object of the invention to provide a port closure which is arranged to withstand a fluid pressure from without the conductor in which the port is located as great as the pressure which the conductor will withstand, and which may be displaced outwardly from the port by substantially smaller fluid pressure from within the conductor.

Another object of the invention is to provide a port closure, of the character described, which is readily interchangeable in the port in the conductor, whereby plugs may be renewed or interchanged to meet varying conditions in the use of the conductor.

Additional objects and advantages of the invention will be apparent from a reading of the following description of a device constructed in accordance with the invention, and reference to the accompanying drawings, wherein:

Figure 1 is a view partly in elevation and partly in section, of a device constructed in accordance with the invention and showing the same installed in a conductor,

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Figure 2 is a continuation of Figure 1 illustrating a transverse vertical sectional view of a removable plug or plunger which may be used in the conductor in combination with the port closure,

Figure 3 is a fragmentary view showing an end elevation of the port closure,

Figure 4 is a fragmentary transverse vertical sectional view of a modified form of closure plug for the port,

Figure 5 is a fragmentary transverse vertical sectional view of another form of closure plug for the port,

Figure 6 is a similar view showing another manner of mounting the closure plug in the port, and

Figure 7 is a fragmentary transverse vertical sectional view of a modified form of closure plug and port.

In the drawings, the numeral 10 designates a tubular housing having an axial bore 11. Internal screw threads 12 are provided at each end of the bore of the housing, whereby the housing may be connected in a flow conductor T. The bore of the housing is substantially the same as the bore of the conductor so as to provide a substantially unrestricted flow passage therethrough.

As is clearly illustrated in Figure 1, the housing is provided with a central external annular flange 13. A lateral opening or port 14 is formed in the mid-portion of the flange 13, and the outer portion 15 of the port is enlarged in diameter and provided with internal screw threads, whereby an outwardly facing annular shoulder 16 is formed at the inner portion of the port.

A closure assembly C is mounted within the port. The closure assembly includes a bushing 17 which is provided with external screw threads and adapted to be threaded into the enlarged outer portion 15 of the port. The bushing is provided with an axial bore which is reduced in diameter at its inner end 18 so that an outwardly facing annular tapered stop or seat 19 is formed in the bushing near its inner end. A short distance beyond the seat 19, the bore of the bushing is enlarged to form a shoulder 20, and the bore beyond this shoulder is provided with internal screw threads 21. A closure member or plug 22, having its inner portion bevelled to conform to the seat 19, is positioned within the bushing to close the bore thereof and thereby close the port 14. A shear plate or disc 23 having a diameter greater than that of the plug 22 is securely confined between a follower ring 24, of the same diameter as the plug, and the outer

end of the plug, the assembly being held together by means of a screw 25 which extends through the ring and disc and into a threaded recess in the center of the plug.

The plug is held tightly within the bushing 17 by means of a clamping sleeve 26 which is provided with external screw threads and adapted to be threaded into the enlarged bore 21 of the bushing to engage the annular shear disc 23 which projects beyond the periphery of the plug into the enlarged portion of the bore of the bushing, so that the disc is clamped securely between the shoulder 20 and the inner end of the clamping sleeve.

It will be noted that, when the closure assembly is in place, the plug engages and is held securely against the seat 19 and the disc 23 is securely clamped in sealing relationship between the shoulder 20 and the clamping sleeve 26. Obviously, any pressure fluid acting upon the plug assembly from the exterior of the housing will only serve to urge the plug more tightly against the seat 19, and thus displacement of the plug inwardly of the port is prevented. Since the disc 23 is clamped securely between the shoulder 20 and the clamping sleeve 26, displacement of the plug outwardly from the port is initially prevented. However, by the application of a sufficient pressure differential from within the housing, the plug may be forced outwardly from the port to permit flow of fluid therethrough. The fluid pressure will move the plug outwardly of the bore of the clamping sleeve and will thus shear off that portion of the shear disc 23 extending beyond the external diameter of the plug to permit the plug to be completely displaced from the bushing and sleeve. By varying the thickness of the shear disc, it will be seen that the pressure differential required to be exerted across the plug to displace the plug may be controlled and predetermined. Therefore, the plug may be so secured within the port as to be displaceable at various predetermined pressure differentials. Also, in some instances it may be very desirable to make the plug from a high shear strength material and to make the shear disc of low shear strength material such as lead or copper. In this manner, the shear disc may be made thicker and more accurate control of its shear strength obtained than if it were made of a very thin piece of higher shear strength material.

Since the thickness of the plug and the length of the small bore 18 of the bushing are each made substantially equal to the wall thickness of the flow conductor T, it is obvious that the device will withstand substantially as great an externally applied fluid pressure as will the conductor itself, since either the large portion of the plug, or the length of the reduced portion of the bushing, must be sheared to permit inward displacement of the plug to the port. Thus, the device may be used in conductors wherein there are high pressures exteriorly of the conductor without decreasing the strength thereof or interfering with the normal operation of the conductor.

Since the thickness of the shear disc is substantially less than the thickness of the entire plug, it will readily be seen that the entire thickness of the plug prevents the plug from being displaced inwardly by the fluid pressure, while only the very much smaller thickness of the shear disc prevents displacement of the plug outwardly from the bushing. Or, the plug may be made of high shear strength material while the shear disc may be made of a relatively low shear strength material. Therefore, the shear disc may be sheared from the plug assembly by relatively small pressure differentials to permit the plug to be displaced outwardly from the bore of the bushing and the sleeve.

When it is desired to open the port, it is only necessary to provide some means for closing the bore of the conductor beyond the port and to apply fluid pressure within the conductor to displace the plug from the bushing. Such a closure means is illustrated in Figure 2.

A coupling member 30, having a bore 31 which is reduced at its mid-portion to provide an annular seat or shoulder 32 therein, is connected in the flow conductor T beyond the housing 10 by means of screw threads 33 formed at each end of its bore. The reduced diameter of the seat 32, which is slightly less than the diameter of the bore of the conductor, does not materially interfere with the normal operation or the flow of fluid through the conductor. When it is desired to open the port, a removable plunger 34 is inserted in the flow conductor to seat upon the shoulder 32 in the coupling member, whereupon said plunger closes off the bore of the conductor to prevent flow therethrough past said coupling member. Thus, fluid may be pumped into the conductor to build up a fluid pressure therein which will readily displace the plug 22 from the bushing 17 and permit flow of fluid outwardly through the port.

The plunger may be of any desired type, such as a large ball, but is illustrated as having a body 35 with an annular bevelled seat 36 at its lower end. The diameter of the plunger body is reduced above the seat and a cup-shaped packing ring 37 is mounted on this reduced portion, being held thereon by a spacer thimble 38 and a retaining nut 39. The upper portion of the plunger body is still further reduced in diameter to form a retrieving connection 40, whereby the plunger may be engaged and removed from the conductor, if desired, by means of a suitable retrieving tool (not shown).

The engagement of the plunger with the shoulder 32 in the coupling member may of itself provide ample closure of the bore of the conductor to permit application of a pressure fluid differential sufficient to displace the plug 22 from the port in the housing. However, if such is not the case, the cup-shaped packing 37 will engage the wall of the conductor to seal off around the plunger and prevent all fluid leakage past said plunger.

Manifestly, more than one of the port closures may be provided in the same flow conductor, whereby the ports may be opened at different positions in the bore of the conductor. It may also be desirable, when more than one of the devices are connected in the same conductor, to provide for opening the different devices at different pressure differentials. This may be done by providing the plugs with shear discs of different thicknesses or of different shear strength materials, as has already been explained.

It is readily apparent that the closure assemblies may be secured in the port of the housing in various suitable manners. Also, the shear element on the plug may differ from that already described. In Figures 4 through 7, we have illustrated modifications of the invention differing from that form just described.

In Figure 4, the shear disc is shown as made

integral with the plug. Otherwise, the closure assembly is identical with the form previously described. A plug 50 is provided with an external annular flange 51 formed integral with its outer end, and this flange is held securely in place against the shoulder 20 by the clamping sleeve 26. Since the flange is of substantially less thickness than the thickness of the entire plug, it will readily be seen that, while the entire thickness of the plug prevents inward displacement thereof by fluid pressure, only the very much smaller thickness of the flange 51 prevents displacement of the plug outwardly by a fluid pressure differential from within the conductor. Therefore, the flange may be sheared from the plug by a relatively small pressure differential to permit the plug to be displaced outwardly from the bore of the bushing and the sleeve.

If desired, the shear disc may be formed of a very soft metal, such as lead, to provide for ready displacement of the plug at low pressures. A structure which is adapted for the use of such a disc is illustrated in Figure 5. A plug 55 seats within the bore of a bushing 56 which is threaded into the port to the bore 15 of the port in the same manner as has been previously described. However, in this form, the bushing is provided with a bore which is substantially the same or only slightly larger than the external diameter of the plug. An enlarged annular groove 57 is formed in the bore of the bushing just beyond the outer end of the plug and a suitable metal may be poured, pressed, cast or otherwise placed, in this annular groove to form a shear disc 58 at the rear of the plug. It will readily be seen that the thickness of the plug and the disc prevent displacement of the plug inwardly of the port, but that pressure from within the housing will force the plug outwardly of the housing to shear the disc 58 and permit complete displacement of the plug from the bore of the bushing.

Obviously, the bushing 17, illustrated in Figures 1 and 4, may be omitted if desired. Such a structure is illustrated in Figure 6, wherein the plug and clamping sleeve are mounted directly in the port formed in the housing. The inner portion 60 of the port is reduced in diameter whereby an annular tapered seat 61 is formed near the inner end of the port. A short distance beyond the seat 61, the bore of the port is enlarged to form a shoulder 62, and the bore beyond the shoulder is provided with internal screw threads 63. A closure member or plug 22, identical with that of the form first described, is positioned within the port to close the bore thereof, and is held securely in place in the port by means of a clamping sleeve 26 which is provided with external screw threads and adapted to be threaded into the threaded portion 63 of the port. The shear disc 23 is securely clamped between the shoulder 62 and the inner end of the clamping sleeve in the same manner as was the disc of the form first described.

In this form of the invention, we have merely omitted the bushing 17 and mounted the plug, shear disc and clamping sleeve directly in the housing port. The operation of this form of the port closure is the same as that of the form first described.

In the port and closure illustrated in Figure 7, the housing or body 10 is provided with a port 65 having its inner portion 66 reduced to form an internal annular shoulder 67. The large outer portion of the port is provided with screw threads and is adapted to receive a tubular clamping sleeve 68 for securely holding a plug

69 in place in the port against the shoulder 67. The plug is in the shape of a flat disc having an annular groove 70 formed in its outer surface. It is to be noted that the groove is larger in internal diameter than the reduced inner portion 66 of the port whereby the total thickness of the plug overlies the margin of said reduced portion and the total shear strength of the plug resists inward displacement with respect to the body 10. The groove 70 provides a weakened shear section of lesser strength than that of the remainder of the plug, and the plug may be displaced outwardly with respect to the body and port by a predetermined lower pressure from within the housing. The amount of material remaining between the bottom of the groove and the inner surface of the plug determines the shear strength and pressure required to displace the plug outwardly.

Obviously, the flange 13 may be omitted if desired and the housing may be provided with a thickened wall section in which the port may be formed and the closure positioned.

From the foregoing, it will readily be seen that the forms of the invention illustrated in Figures 1, 4 and 5 provide a port closure assembly which may be removed and interchanged for various purposes, such as testing, if desired. In the forms of the invention shown in Figures 6 and 7, the closure plug may be removed and exchanged or replaced if desired, but the entire closure assembly may not be separately tested out of the housing.

It will also be seen that we have provided a port closure plug assembly wherein the entire thickness of the plug and shear disc prevent inward displacement of the plug from the ports, while only the reduced thickness of the shear section or disc prevents outward displacement of the plug. Therefore, the plug will withstand as great a pressure without the housing as will the conductor in which it is connected, while a substantially lower pressure or pressure differential will displace the plug outwardly from the port.

It will also be seen that a plurality of the devices may be used to open ports at various positions within a conductor, and that the various plugs or a single plug may be set for any desired pressure differential to permit opening the port.

The foregoing description of the invention is explanatory only, and changes in the details of the construction illustrated may be made by those skilled in the art within the scope of the appended claims, without departing from the spirit of the invention.

What we claim and desire to secure by Letters Patent is:

1. A port and closure apparatus including, a tubular housing adapted to be connected with a flow conductor and having a flow port extending through its wall; said port having the outer portion of its bore enlarged to form an outwardly facing annular shoulder intermediate the ends of the port and having the inner portion of its bore reduced at a point spaced inwardly from said shoulder to provide an outwardly facing annular sealing seat spaced inwardly from said outwardly facing annular shoulder, a closure plug mounted in the bore of the port and seating in sealing engagement on the annular sealing seat, an annular laterally projecting shear element at the outer end of the plug overlying and engaging against the outwardly facing annular shoulder, and a tubular clamping sleeve

having a bore slightly larger than the diameter of the closure plug threadedly secured within the outer enlarged portion of the port and engaging the shear element to clamp said annular projecting portion of the shear element against said outwardly facing annular shoulder to restrain outward displacement of the plug from the port, said shear member being frangible upon the application of a predetermined force against the plug from within the housing to permit the plug to be displaced from the port.

2. A port and closure apparatus of the character set forth in claim 1, wherein the shear element is separate and releasably secured to the plug by means of a clamping washer and a clamping screw which extends through the washer and shear element and is threaded into the plug, whereby the shear element may be removed and replaced.

3. A port closure assembly including, a tubular bushing adapted to be mounted in a ported member and having one end portion of its bore reduced to form a sealing seat in said bore intermediate the ends thereof and also having the opposite end portion of its bore enlarged to provide a clamping shoulder therein spaced from the sealing seat, a solid closure plug arranged to fit in the bore of the bushing and to seat in sealing engagement upon the sealing seat therein, a shear disc carried by the plug and projecting laterally peripherally therefrom and engaging against said clamping shoulder, and a tubular clamping sleeve threadedly mounted in the enlarged portion of the bore of the bushing and clamping the annular projecting portion of the shear disc against said shoulder to restrain outward displacement of the plug from the sealing seat, said shear disc being shearable upon the application of a predetermined pressure upon the sealing seat side of the closure plug to permit the closure plug to be displaced from the sealing seat through the bore of the sleeve.

4. A port closure assembly of the character set forth in claim 3, wherein the shear disc is separate and releasably secured to the plug by means of a clamping washer and a clamping screw which extends through said washer and shear disc and is threaded into the plug, whereby the shear disc may be removed and replaced on the plug.

5. A port and closure apparatus including, a walled body member having an opening extending through its wall, and a closure assembly for said opening including, a tubular bushing removably mounted in the opening and having the inner end portion of its bore reduced to form a sealing seat in said bore intermediate the ends thereof and also having the outer portion of its bore enlarged to form an outwardly facing clamping shoulder spaced outwardly from said sealing seat, a solid closure plug arranged to fit in the bore of the bushing and seat in sealing engagement on the annular sealing seat therein, a shear disc carried by the plug at its outer end and projecting annularly laterally therefrom so as to overlie and engage against the outwardly facing shoulder in the bore of the bushing, and a tubular clamping sleeve threadedly mounted in the enlarged outer portion of the bore of the bushing and engaging the annular projecting portion of the shear disc to tightly clamp said projecting portion of the disc against the clamping shoulder, said shear disc being shearable between the outer periphery of the closure plug and the inner periphery of the bore wall of the clamping sleeve upon the application of a predetermined pressure against the plug from within the body member to permit the plug to be displaced from the sealing seat through the bore of the sleeve.

6. A port and closure apparatus including, a walled body member having an aperture formed in its wall, an outwardly facing seat formed in said aperture, a closure member arranged to be mounted in the aperture for closing the same, and means for holding the closure member in aperture closing position, said closure member being provided with a thick high shear strength central section and a thin lower shear strength section surrounding said central section and disposed between said central section and the holding means to resist outward displacement of the closure member from the aperture, the thick high shear strength central section of the closure member engaging and seating upon the outwardly facing seat in the aperture to seal the same against inward fluid flow through the aperture, said lower shear strength section being shearable upon the application of a predetermined pressure against the inner sealing seat side of the closure member to permit the thick high shear strength section of the closure member to be displaced outwardly of the aperture to open the same.

HERBERT C. OTIS.
HUBERT C. LAIRD.

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